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MANAGEMENT OF SANDY-LAND FARMS IN NORTH- ERN INDIANA AND SOUTHERN MICHIGAN.

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INTRODUCTION.

This bulletin deals with the problems involved in the improvement and management of farms on the yellow to whitish sandy-land areas¹ which occur in different parts of northern Indiana, southern Michigan, and in a part of northwestern Ohio. It outlines a plan whereby a man with limited means, by beginning with suitable cash crops, may build up one of these farms and at the same time derive some revenue from it, finally developing a well-balanced farm system.

¹Very light gray to whitish-gray solls with a varying yellowish tinge. These solls would generally be classed as sandy loams, but on the whole are quite sandy, grading in some instances to almost pure sand.

NOTE.—This bulletin, while applying particularly to areas where sandy lands occur in southern Michigan, northern Indiana, and a part of northwestern Ohio, should prove of interest to farmers occupying sandy lands in other portions of the country not too far north to permit of maturing the crops recommended.

The conclusions, drawn from investigational work in the region,¹ are as follows:

The growing of soy beans and cowpeas for seed offers a definite approach to the entire problem of farm improvement in these sandy-land areas of the section.

Soy beans and cowpeas are profitable cash crops on the poorest of these sandy lands, the yields ranging from 5 to 20 bushels per acre, and the present range of price \$1.50 to \$2 per bushel, with a possible minimum of about \$1 per bushel when the seed-growing industry becomes well developed in these sections. Aside from being a source of immediate income under these conditions, these crops furnish the most practical foundation for building up the soil, in addition affording considerable feed for live stock.

Most farms on these sandy lands conform best to a cash-crop rather than a live-stock basis at first. As the soil is built up, as feed can be produced and fences built, it is wise to add gradually such live stock as prove profitable.

It is possible to grow alfalfa successfully on nearly all of these sandy-land farms, but not without following certain definite lines of procedure. In addition to making heavy applications of manure it is necessary to incur considerable expense in the purchase of lime and fertilizers. These sandy lands are not naturally adapted to alfalfa, but with careful and persistent effort this crop will become a valuable addition to those already grown on the average farm.

Vetch has not attained the favor on the sandy lands of this section which it has on similar lands farther north in Michigan. This crop requires greater care and attention than soy beans and cowpeas. Inoculation and manure are generally necessary for satisfactory results. When grown successfully it gives good returns as a seed crop. It is also valuable as a crop to plow under in preparation for corn, soy beans, or cowpeas.

In arranging cropping systems there should be two main objects—improving the land and securing a profit. The chapter in this bulletin on "Rotations and Cropping Systems" outlines a number of systems which meet these demands effectively, and likewise apply to the different stages of development on the average sandy farm of the section.

In general the soil of the sandy-land farms of this region is somewhat reduced in fertility, and partial crop failure is not uncommon. To guard against the effects of this in so far as possible, ample provision should be made for growing an abundant amount of home

¹ The writer desires to acknowledge valuable assistance rendered by Col. C. A. Carlisle, John Bordner, and Bro. Leo, South Bend, Ind.; Jason Woodman, Kalamazoo, Mich.; and Judge Frank Williams, Allegan, Mich., for placing their farms and their experience at his disposal as a source of information. Further acknowledgment is due a large number of farmers on these sandy lands who have carried out work at the writer's suggestion.

supplies, meat, etc., for family use. Steps should be taken to make the farm as nearly self-supporting as is practicable, in order that living conditions may be more favorable when years of crop shortage occur.

In undertaking to develop one of these sandy-land farms due consideration should be given to the fertilizer requirements of the soil. In general, however, the use of commercial fertilizers should be postponed until soy beans or cowpeas have been grown on the different fields as the first step in soil improvement. All fertilizer elements give much greater returns after this is done.

Nitrogen and organic matter are of first and perhaps greatest importance in the building up of these lands. For this reason the growing of such crops as soy beans, cowpeas, and vetch is the first step that should receive attention. This alone gives surprising results in increasing crop production.

Phosphorus is the second element of fertility in these sandy lands to receive consideration. However, all forms of phosphate are unprofitable until these soils have been built up somewhat in nitrogen and organic matter. Much better returns for the money invested will be secured if the application of phosphorus is postponed until the much-needed nitrogen and organic matter have been materially increased. If quicker returns are desired the application may be made with a heavy green crop plowed under.

Lime should receive third place in relative importance as an element which these lands need. Ground limestone and marl are presumably the best forms of lime for agricultural purposes, but making light applications of burnt lime with the grain drill is gaining some favor. The application of lime is of about equal value at any stage of the soil-improvement program. It may well be the first step if sufficient means are available, but this is not necessary. It should, however, precede all attempts to grow clover or alfalfa.

Potash is of least importance as an element to be supplied to these sandy lands, but on farms which are extremely run down this step should not be overlooked. Where experiments were conducted under these conditions potash gave good results and greatly increased the value of phosphorus when the two were applied together.

The very common practice of allowing fields to remain idle for one or more seasons is a highly inefficient method of soil management. On some areas of these sandy lands this wasteful practice has become so prevalent as to demand serious consideration. Instead of allowing these fields to grow up to weeds or remain bare and exposed to the sun, it would be much better for the soil, and generally more profitable, to sow soy beans or cowpeas.

Live stock should become a feature in the development of these sandy-land farms as soon as conditions will warrant it and insure a

profit. The first reason for introducing live stock is to make provision for feeding soy beans and cowpeas and thus guard against a possible slump in the price of seed from these crops when seed production becomes more thoroughly developed. The second reason is that in addition to adding greater diversity of income and greater stability to the farm system, live stock, if made profitable, will furnish a much-needed means of profitable employment on the sandy farms of the area during the winter months.

Dairying is one of the first and most natural lines of live-stock farming to suggest itself on the sandy-land farms which are suitably located with reference to milk markets or shipping stations for cream. This bulletin gives only the preliminary steps for starting such farms. Soy beans and cowpeas for hay, with the possible addition of Sudan grass for hay, make it possible to start this industry with little expense. Brome grass (*Bromus inermis*) bids fair to supply the urgent need of a good summer pasture grass.

Hog raising, either alone or with dairying, is feasible on these lands as soon as the soil will produce 30 to 40 bushels of corn per acre with reasonable certainty. This industry requires less consideration of the distance of the farm from market. Field peas, commonly known as Canada field peas, grown to hog down, and soy beans—either for pasture when in blossom or for hogging down when ripe, or for winter feed, fed as hay out of the stack or from the barn—are each a valuable factor in the economic production of pork on these sandy-land farms. This bulletin gives preliminaries only.

On the west side of Michigan the northern limits of the sandy areas under consideration include the greater part of the sandy lands of Allegan County, except the lighter sands of the extreme western and northwestern parts; and on the east side of the State the most northern limits cover the limited areas of Oakland and Macomb Counties; but, as a whole, the plans outlined in this bulletin do not apply to sandy lands farther north than these arbitrary boundaries. In no case should this bulletin be so construed as to include the sandy "pine plains" or "Jack pine lands."

LOCATION OF THE SANDY AREAS.

The sandy lands of this general and widely extended area do not occur in one continuous body. In Michigan the principal and most typical areas are in the southwestern part of the State, but the work on which this bulletin is based covers the extensive sandy-land areas in southeastern Michigan, and Fulton and Lucas Counties in Ohio. The central counties of southern Michigan are comparatively free from sandy lands, but where these occur the principles outlined in this publication apply with equal value.

In Indiana the northern tier of counties contains the largest areas of typical sandy lands in that State. In addition to this, sandy lands in smaller and less continuous areas, and generally of better quality, occur throughout the counties of Jasper, White, Pulaski, Starke, and Marshall; and in parts of Cass, Fulton, Kosciusko, Whitley, and Noble.

GENERAL CONDITIONS.

On much of the typical yellow and gray sandy lands of this region agriculture in general has been somewhat backward for a number of years. The farms as a rule have been under cultivation for a comparatively long period. The sandy soils have been free to liberate the elements of fertility, which have been gathered in crops and sold off with no provision for keeping up production. The period of heaviest crop yields and greatest prosperity has long since passed. Good houses and barns are still common, but these often tell only of former thrift. In many instances yields have been so reduced that the average farm now fails to pay a reasonable income and often affords the owner and his family little more than a mere living.

Fences in general are poor. This makes it almost impossible to keep the smaller classes of live stock out in the fields. Consequently such live stock as sheep and hogs are few in number. What few are kept are confined to relatively close quarters. Generally only enough hogs are raised to furnish meat for the family. Occasionally a few are butchered for sale in the nearest home market, but seldom more than four or five per year. The live stock, therefore, on the average farm is very limited.

There are no very definite systems of farming established on these sandy-land areas. Different crops are grown and sold on the market, but a fixed rotation is rarely practiced. In changing crops from field to field, clover is necessarily omitted because of the very great uncertainty of this crop on these lands under present conditions. Cowpeas are taking the place of clover, but as yet not to the extent of being a part of a regular rotation. For the most part the crops are corn, wheat or rye, and some oats. After several years of cropping the fields in turn lie idle without cultivation and grow up to weeds. Idle fields left in this condition are numerous, and these at times give the sandy-land areas of this section rather a neglected appearance.

THE BIG PROBLEM.

Under present conditions the most difficult problem in connection with these sandy lands is not to outline minutely the conditions which prevail, discover the needs of the soil, nor point out the faults of present farm practice and suggest farm systems which

will be ideal after these farms have been built up and made productive. The greatest difficulty lies in the start. The real problem is to find a practical plan whereby a man on a poor farm, and with limited means, may begin at once to make a profit, and from this build up the farm and develop a well-balanced and profitable farm system. It is comparatively easy to suggest remedies and to point out what should be done, but it is quite another thing to make the money on a poor farm to follow out these suggestions. It costs money to buy the fertilizing elements and lime which may be needed. It is expensive to grow crops and plow them under. It takes real cash to pay for fences which will turn live stock. There must be something to yield an immediate and fairly certain and continuous income. How to get this out of a depleted farm, and at the same time build it up, is the big problem on these sandy-land areas.

SOY BEANS AND COWPEAS.

The key to the situation as here proposed lies in the production of soy beans and cowpeas, first for sale as seed and later as feed for live stock. These crops, under present conditions, offer the quickest and surest source of income on the sandy-land farms of the area, and make it possible to start the poorest of these farms toward a distinct betterment, while affording a reasonable income to the owners. From this beginning it is possible to introduce other suitable enterprises, including live stock, and thus to establish well-balanced and profitable systems of farming which are more general and diversified in nature and more certain of continuous income.

While similar in many ways, each of these crops has some points of advantage over the other. In the beginning, cowpeas require less attention than soy beans. Throughout the entire extent of these sandy lands it has not been necessary to inoculate cowpeas; whereas it is highly necessary to inoculate soy-bean seed in order to secure good results on new fields. This, however, is a simple matter. Inoculating material, with full directions, may be secured free of charge on request to the United States Department of Agriculture, at Washington, D. C. Small sacks containing about one quart of inoculating soil¹ may generally be obtained from farmers who grow the crop for seed. These may be shipped by parcel post or by express at a very small expense. Another apparent advantage of cowpeas over soy beans is that cowpeas are generally sown broadcast with the grain drill, either leaving all the holes open or stopping up every other one; whereas soy beans should be sown in rows about 32 inches apart

¹ The seed may be inoculated by stirring enough inoculated soil in milk-warm water to make it thoroughly muddy and sprinkling this over the beans a few hours before starting to sow them. An application of 300 to 500 pounds of inoculating soil per acre is effective, but in general the advantage does not justify the extra labor and expense.

and should be cultivated. After the inoculation is thoroughly established, fair success may be obtained with soy beans sown broadcast, the cultivation of the crop being done entirely with the spike-tooth harrow, but this method is uncertain at best and the crop often suffers greatly from weeds.

Thrashing cowpeas is much more difficult than thrashing soy beans. It requires special machinery to thrash cowpeas successfully; but the ordinary separator will thrash soy beans, provided a few minor adjustments of the pulleys are made to allow the cylinder to turn at a slower rate than for wheat or oats and still keep up the speed of the remainder of the machinery.

Both crops make excellent hay, which is valuable for feeding live stock. Soy-bean hay, which contains the ripened beans as well as the leaves, is about equal to alfalfa. Cowpea hay ranks lower in feeding value, but if cut when mature it compares very well with clover.

When ripe, each crop may be gathered by hogs or "hogged off"; but only the soy beans can be used successfully for hog pasture or forage. Hogs will eat the green leaves of the soy-bean crop at any stage of its growth, but ordinarily will not eat cowpeas in this manner, simply eating the pods of the cowpeas when ripe. On the other hand cowpeas are generally preferred for pasturing cows. This practice is gradually spreading, and it is now very common to sow cowpeas regularly for the double purpose of pasturing and improving the land. Thus, while both crops are valuable, and are similar in nature and cultural requirements, each has its distinct place of importance and bears a slightly different relation to the general problems to be dealt with. Everything considered, on these sandy lands the soy bean is the more valuable crop of the two.

SEED PRODUCTION.

The two crops of greatest value in beginning the work of improvement on any and all farms on these sandy-land areas, and which fill the most rigid requirements as cash crops, are soy beans and cowpeas for seed. Under all the conditions found these crops may be grown profitably at once, without expensive fertilizers, and may be made most effective in the important work of soil improvement.

Since both crops grow successfully on the poorest of these sandy farms without fertilizers, the start may be made with very little expense except for seed. The income that may be expected for the first two or three years will be about the same from cowpeas as from soy beans; but after the soil becomes thoroughly inoculated for soy beans this crop will do much better than cowpeas. The yields from each will vary greatly according to the productiveness of the soil. The variation runs from 5 to 20 bushels per acre, with 12 bushels

as a very good average. Some of the best growers have been able to average 15 bushels, with a maximum yield of 25 bushels per acre. So far \$1.50 to \$2 per bushel has been nearly a standard price, when sold on the local market, or to other farmers for seed. The demand has been good, both from local farmers and from seedsmen in South Bend, Ind., and Jackson, Mich., who supply the local trade and ship to other sections of the country where northern-grown seed is desired. Judging from other sections where soy beans are grown extensively for seed, prices may possibly drop as low as \$1 per bushel. Even this figure permits of a good profit on these sandy lands. It is easily possible for this section to establish a profitable



FIG. 1.—A good growth of cowpeas for seed production.

industry by growing a good quality of seed, both of soy beans and cowpeas.

Early varieties which have been grown in northern latitudes must be sown, in order to make sure that the seed will mature. The seedling for both crops should be done about June 1, and not earlier, as a rule, than May 25. During short seasons, such as 1915, late-sown cowpeas do not produce good crops of seed in this region. Under these conditions soy beans are generally better for seed, because this crop is injured less by early frosts. Of the varieties of cowpeas tested, New Era, Whippoorwill, and Groit have given best results. The Ito San variety of soy beans has been the most satisfactory. Some new varieties of soy beans brought from Manchuria by the United States Department of Agriculture are giving promise of even

better yields than any of the older varieties so far tried out. It is highly important in an enterprise of this nature that the growers of each section grow the same varieties and standardize their products, so that uniform earload lots may be put on the market.

The illustrations (figs. 1 and 2) give a good idea of the success with which these crops are grown on these sandy lands, as well as something of the difference in methods used in growing each.

The crop of cowpeas shown in figure 1 was grown near Granger, Ind., on poor sandy land with the application of about 300 pounds per acre of a fertilizer containing 2 per cent nitrogen, 8 per cent phosphoric acid, and 10 per cent potash. This amount of fertilizer



FIG. 2.—A good crop of soy beans growing on sand, showing the rows and method of cultivation.

is more than it would be profitable to apply under average conditions, and the per cent of potash is probably higher than is necessary. Five per cent of potash generally gives good results, but even this amount is prohibitive under the extreme conditions of 1915 and 1916. Unfortunately there was no machine available to thrash this crop and no data were secured as to yield. It may be said, however, that this is a better crop than should be expected under average conditions throughout the area without the aid of liberal amounts of fertilizer.

The soy beans shown in figure 2 are not mature; hence the illustration does not show this crop to the best advantage. However, it shows a vigorous growth, well advanced for the season, which later

produced a splendid crop of seed. The soil in figure 2 is a fine sand, naturally poor, but not seriously run down. This is the second year for soy beans on this field, and the growth is much better than it was the first year, on account of the soil being more thoroughly inoculated and the nodule development on the roots much more perfect. The third year the crop is generally better than the second for this same reason, and because of the available nitrogen in the soil from the roots of the two previous crops. After the second and third year the addition of phosphorus and potash becomes very effective in further improving the soy-bean crop or in growing larger yields of other farm crops.

While the business of growing soy beans and cowpeas for seed affords the best means of immediate returns in beginning the process of farm improvement on these sandy farms, this industry may well be continued as a part of a more diversified farm system when other cash crops may have been added and when the soil has been built up. In many instances potatoes may be grown to advantage after the land has been sufficiently improved, but not under the average soil conditions which exist at present. Vetch, also, when sown with rye, may be made a profitable cash crop, if a suitable machine is available for separating it from the rye. A gravity machine is being used successfully for this purpose in several counties in southern Michigan. For the first few years, however, more attention should be centered on soy beans and cowpeas for seed, and from this further progress may be made gradually until the stage is reached when it is wise to introduce more or less live stock.

THRASHING COWPEAS.

One of the greatest drawbacks to a rapid development of the cowpea seed industry on an extended scale is the difficulty in thrashing the crop. An ordinary thrasher will not do the work satisfactorily. The pods are very tough, and the vines generally wrap around the cylinder, thus choking the machine. What peas are thrashed out in this way are very badly cracked and broken. The only solution thus far found for this problem is to get special machinery for this purpose. On these sandy lands it has been necessary to do this in order to place the cowpea-seed industry on a footing that will make it profitable, and at the same time make it one of the definite stepping stones to the improvement of the soil and to better systems of farm management.

After considerable experimenting, a machine was found that does the work in an ideal manner, and yet sells at a reasonable price. This type of machine costs \$350, and the freight to most points in the area is about \$50 additional. This puts the outfit within reach of a community of farmers; and no doubt as the acreage of cowpeas in-

creases men who make a business of thrashing will add a similar machine to their equipment.

The main feature of a cowpea and bean thrasher of this type is the cylinder, which is very strong, and has sharp, knifelike teeth. The concave teeth are also of a special design, a part of which are sharp and similar to those of the cylinder. This arrangement makes it possible to thrash cowpeas without cracking more than 1 per cent, and at the same time it shreds the pods and vines perfectly. Such an outfit is not necessary for thrashing soy beans, but it handles this crop equally well. Figure 3 shows this machine in operation.

The illustration in figure 3 gives a fair idea of the efficiency of this machine. It is of good capacity, and is being operated in this instance by a 5-horsepower gasoline engine. To get the best results



FIG. 3.—Thrashing cowpeas, Granger, Ind.

under all conditions an 8-horsepower engine would be better. This outfit has been in use for three years. The first season it thrashed 200 bushels of cowpeas in small jobs on near-by farms, the second 1,000 bushels, and the third 1,500 bushels, and could not get to all the jobs that were available. This shows the increase in the acreage of this crop since this machine has been placed at the disposal of the farmers of that immediate community.

ALFALFA ON THE SANDY LANDS.

In working out farm problems and systems of farm management for a related agricultural area the question naturally arises: What place has alfalfa in the general scheme? It may be said that on small acreages here and there over these sandy lands alfalfa is growing

successfully. This, however, has not come about by careless methods, nor without considerable effort. There is a certain line of procedure necessary in nearly all cases. An application of from three to five tons per acre of either limestone or marl is the first important step. When marl may be had cheaply much heavier applications will prove profitable. It is better, also, to have grown soy beans on the land for two years previous to the first trial with alfalfa, to afford a good supply of available nitrogen to force the growth. Then, a rather heavy application of manure is a good thing, but not always necessary for success. August 1 has proven the most satisfactory time for sowing the seed, although some few have had excellent success by sowing very early in the spring, or about as soon as the frost is out of the ground. Inoculation is always necessary for complete success. The best and most reliable method for these sandy lands, as determined by actual farm practice, is to sow broadcast from three to five tons of inoculated soil per acre and harrow the surface thoroughly. This soil should be taken from a sweet clover patch, or from an old alfalfa field where the alfalfa is known to have the nodules well developed on its roots. If this method is impossible the alfalfa seed may be inoculated either with a small amount of soil or by artificial cultures furnished by the State or the United States Department of Agriculture. If the soil is well limed any of these methods should be effective.

While the lower depths of the soils of these sandy areas are doubtless deficient in lime, yet, if the first 8 or 10 inches of the surface is thoroughly limed, this deficiency in the subsoil proves no hindrance to the growing of alfalfa, since it is in these first few inches of depth that about all the nodules are formed on the roots, even under ideal soil conditions.

The sandy lands of northern Indiana and southern Michigan are not naturally well adapted to alfalfa, but if proper methods are followed, and the required amount of labor and expense is given, this crop can be successfully grown throughout practically the entire extent of these lands. The start should be made with only a small acreage, which can be extended later as the grower sees fit and as his experience broadens.

VETCH AS A FARM CROP.

Vetch so far has not received the wide recognition throughout these sandy-land areas which it deserves. Under conditions which prevail, vetch is much more uncertain than soy beans or cowpeas. This uncertainty, together with the prevailing high price of seed, has greatly hindered its introduction. The first few attempts on the poorer sections of the sandy-land areas are generally failures. To make sure of success from the very beginning manure is generally necessary. This

is not often available, especially in large quantities. Inoculation is also essential if the full value of the crop is to be realized. When grown successful for seed on these sandy lands, vetch becomes a very profitable cash crop. Other than this its main value is that of a crop to plow under to enrich the soil.

In growing vetch for seed it is necessary to grow it with some crop like rye to prevent it from lying flat on the ground. Until recently the greatest objection to this was the difficulty of separating the two so that the vetch seed may be sold on the market when thrashed. Now, an inexpensive gravity machine is available which does this work very effectively. Full information concerning this device may be secured by writing the Bureau of Plant Industry, United States Department of Agriculture, Washington, D. C. As a source of cheap seed for farm use each year, a small acreage may be sown with vetch and rye seed mixed. This mixture, which may be thrashed and sown again without any necessity of separation, will thus furnish the seed for the following crop.

For the first trial with vetch, a small field should be plowed about the middle of July and made ready for sowing the vetch and rye about August 1. In preparing the seed bed, a light application of manure should be worked into the surface of the soil. This, and the inoculation of the vetch seed, will generally insure success under very unfavorable soil conditions. Each year the crop grows on the same land the inoculation becomes more thorough and the growth better. Applying on each acre from 300 to 500 pounds of soil from a well-inoculated vetch field and working it into the surface thoroughly is perhaps the most effective method of inoculation, as soon as this is possible. After all the fields of a given farm will produce vetch successfully the vetch and rye seed may well be sown in the standing corn. This may be done by sowing the seed broadcast and covering it with a one-horse cultivator, or better still, by sowing with a small grain drill which goes between the rows.

Since so much of the value of vetch depends upon the relative success with which it is grown, the details of managing this crop should be thoroughly mastered in the beginning. Farmers' Bulletins Nos. 515 and 529 will be helpful in this connection. These may be secured on application to the Division of Publications, United States Department of Agriculture, Washington, D. C. Although less certain than the soil method of inoculation, liquid cultures for inoculating vetch seed, with full directions, may be secured free of charge by applying to this department. To avoid delay, application should be made two or three weeks before ready to sow the vetch seed.

Where wheat is a regular crop in the rotation, vetch for seed should not be grown, as it is very difficult to separate it from the wheat.

Volunteer vetch will prove troublesome in the wheat fields, and on the better farms, where wheat growing is profitable, it is better to omit vetch as a seed crop and grow soy beans and cowpeas instead. Vetch may be grown on the same farm with wheat if the vetch is used as a catch crop and plowed under before the seed ripens.

Although somewhat uncertain on new fields for the first two or three trials, or until the inoculation becomes thoroughly established, vetch will grow successfully over most of the sandy-land areas, provided the details are well carried out in starting it on fields where it has not been grown before. If a small field is selected for the first trials and the crop grown for two or three years in succession on the same field the immediate results will be much more gratifying. The soil of this field will then be valuable as inoculating material in starting vetch on the other fields of the farm. Vetch is one of the best crops available for building up the nitrogen and organic matter of these sandy lands. With due consideration for the uncertainty in the first few attempts to grow this crop, its value should attract greater attention, and eventually it should hold a prominent place on the sandy farms of the area.

SUDAN GRASS.

Sudan grass is of very recent introduction in the area. Up to the present it has been grown only in small patches, but with considerable success even on rather thin land. From all indications its popularity should increase. It will doubtless become more or less of a factor in the development of a large number of farms on these sandy lands. On fairly good soil, or on land which has been built up somewhat, this crop produces large yields of hay which is greatly relished by all classes of live stock on account of its sweetness. Sudan grass belongs to the sorghum family, and, being rich in carbohydrates, it should be fed with some feed correspondingly rich in protein. If this precaution is not taken, much of its value is lost. When fed with soy bean, cowpea, clover, or alfalfa hay, it is especially valuable for dairy cows.

This crop draws heavily on the fertility of the soil, and it possesses no qualities for building it up, as do soy beans, cowpeas, vetch, or field peas. This should be considered and ample provision should be made for keeping up the fertility of the soil by growing legumes and by the addition of manure or fertilizers.

Sudan grass should be sown about June 1 in these sections. Usually it is sown in rows and cultivated. The principal reason for this has been the cost of seed, but recent prices make this unnecessary. There is no reason why this crop should not be sown broadcast with the grain drill when seed prices permit. When rightly managed, a small acreage of Sudan grass should prove profitable and desirable on a large number of farms throughout these sandy-land areas.

BROME GRASS.

To obtain suitable pasture throughout the summer season is a serious problem on these sandy lands. Everything considered, it is probable that brome grass (*Bromus inermis*) is the best grass available for this purpose. Its native home is on the sandy plains of Hungary. In the United States it has become important only in the dryer regions; but it is not generally known that this highly productive, nutritious, and palatable hay and pasture grass is well adapted to sandy lands in the more humid sections. It is almost entirely unknown in this immediate region, but in one instance in Kalamazoo County, Mich., it has been grown for 15 years on very sandy land and with highly satisfactory results. The main difficulty has been in securing brome-grass seed free from the seed of quack grass. This has prevented the further introduction of brome grass in that immediate section. Provided brome-grass seed reasonably free from quack grass can not be obtained from responsible local dealers it may be feasible to buy it in large lots from western farmers. It has been successfully produced by farmers in eastern Washington and on some of the extremely sandy soils in northern Minnesota. It gives considerable promise on the sandy land of this section and deserves a thorough trial, first as a pasture grass and second as a hay crop.

ROTATIONS AND CROPPING SYSTEMS.

Some definite plan for a succession of crops is essential in beginning the improvement of the sandy-land farms of this section, if the greatest possible progress consistent with reasonable profits is to be made. As the improvement advances through the various stages the needs of the farm will naturally suggest changes toward rotations better suited to the stage of development which has been attained. The first stage, being that of growing and selling cash crops, most naturally calls for as large an acreage of such crops as can be grown to advantage.

CONTINUOUS CROPPING WITH SOY BEANS.

Beginning with the initial stage of the plan of farm improvement, and with soy beans as the cash crop, a good system to follow for a number of years is to provide for producing relatively liberal amounts of corn and hay, and then to grow soy beans for seed over as much of the remainder of the farm as it seems wise to do under existing conditions, and on the same fields for two or more years in succession, simply alternating with a catch crop of rye. After the soy beans have been harvested each year the soil should be thoroughly disked and rye should be sown. Usually this will be rather late and the rye will not make much growth during the fall season, but it will come on well in the spring, and by May 25 will have

reached a splendid stage for a green-manure crop. At this time it should be plowed under in preparation for the next crop of soy beans.

The soy-bean seed must be thoroughly inoculated the first year; after that the crop improves from year to year as the inoculation becomes more thorough. This is the main reason for continuing the soy-bean crop for more than one year on the same land. In addition to this, plowing down the rye each year furnishes much needed vegetable matter which improves the soil greatly. Under normal conditions, commercial fertilizers may be used to advantage with this system after the second year. If raw rock phosphate is used it should be applied with the rye crop which is plowed under. After this system has been carried out for three years on a given field, other practices may be introduced and other crops grown which will form a more extended rotation.

The merits of this system of cropping, however, in beginning the improvement of the poorer class of sandy-land farms, can not easily be overrated. It yields a profitable crop for sale each year, and one also to be plowed under on the same land. Adding to this the amount of available nitrogen which the soy-bean crop adds to the soil, the general improvement is very rapid. A further step may well be taken by feeding the hay resulting from thrashing the soy beans and returning the manure to the land as soon as possible. If the hay is not fed it should be used as bedding and then scattered out over the rye during the winter and early spring.

Practically the same cropping system can be carried out with cowpeas for seed with about the same results, except there will be no improvement in the cowpeas due to better inoculation from growing the crop more than one year on the same land. In fact, it is better to change the cowpeas to a new field each year in a rotation with other crops.

TWO-YEAR ROTATION, INCLUDING CORN.

In many instances it may be more desirable to start with a definite rotation and make that rotation include corn as well as soy beans or cowpeas. The two-year rotation which will accomplish this best runs as follows:

First year	-----	Corn.
Second year	-----	Soy beans or cowpeas.

A catch crop of rye and vetch may well be sown in the standing corn, or rye alone after the corn is cut. This may be allowed to grow till about May 25, when it should be plowed under to prepare for a crop of soy beans or cowpeas to be grown for seed.

This rotation will gratify a very common desire to grow soy beans or cowpeas one year and the next year follow with corn. In this some caution should be observed. Such rotation may for a time in-

crease the yield of corn materially, but may eventually prove a means of further and more completely reducing the fertility of the soil. The crop of soy beans or cowpeas will add available nitrogen and this will stimulate the growth of the corn, causing it to take up greater quantities of the mineral elements of the soil. If, then, the corn crop is sold off the farm for a number of years, and no manure is returned to the fields, the results will be destructive rather than beneficial. This should be avoided as far as possible, and each year, in addition to plowing under the catch crop of rye and vetch or of rye alone, some fertilizer should be used with the special idea of keeping up the supply of phosphorus.

This rotation may be employed in connection with dairying if some provision is made for summer pasture, or without pasture if sufficient silage is produced to feed during the entire year. The growing of a small acreage of alfalfa may well be added also, if conditions will permit. This rotation may likewise be used in the early efforts with hog raising. It is best suited, however, to the system in which only one litter of pigs is raised each year, this being the late summer or early fall litter. In introducing live stock of any kind with this rotation, it is well to keep the cash-crop idea as the more important feature of the system until the process of the development of the farm is well advanced.

THREE-YEAR ROTATIONS.

The 2-year rotation just considered may easily be extended into a 3-year rotation. This can not be done, however, without sacrificing to some extent the opportunities of adding features of special value in soil improvement. As a 3-year rotation it would run in the following order:

First year	-----	Corn.
Second year	-----	Rye, or rye and vetch.
Third year	-----	Soy beans or cowpeas.

This arrangement would permit of harvesting three different crops each year, and in respect to introducing greater diversity this is valuable. The extended period of rotation, however, permits the legume, either soy beans or cowpeas, to grow on the same field only once in three years, and in this way is less effective in adding nitrogen. The feature of having a catch crop of rye or rye and vetch to plow under in preparation for the soy beans or cowpeas may be retained by disking the field after the rye crop or the rye and vetch has

been harvested. There is always enough shattered grain to give a fair stand which will attain a good growth by May of the next spring.

Better suited to later stages of development of sandy-land farms in this region is the ordinary 3-year rotation with clover, arranged in the following manner:

First year.....	Corn.
Second year.....	Rye.
Third year.....	Clover.

Before such a rotation can be put in operation, however, on the average sandy-land farm of the area, the soil must be put in good condition to grow clover. Generally this requires considerable time and some extra expense; but where the farm can best be managed in three fields, with possibly one or two smaller fields for pastures and lots, it might be well to begin at once and make ready for such a rotation, even if the immediate expense is greater. In this case one of the first steps should be to apply ground limestone on one of the fields immediately, or as soon, at least, as possible. This should be done during the winter or early spring, and it would be well to disk the surface afterwards, if sufficient time is available. During the latter part of May the field should be plowed, made ready, and sown to cowpeas. About August 1 the crop of cowpeas should be plowed under, the land thoroughly prepared, and sown to clover. The clover seed should be sown alone and covered by harrowing. The next season a fairly good crop of hay ought to be produced, and possibly a second crop to be plowed under if desired, or to be cut for seed or hay. Each field should be handled in this manner in succession until the entire farm will grow clover successfully.

It should be kept distinctly in mind, however, that this applies to the sandy-land areas only. Seeding clover in the late summer or early fall on heavy silt or clay loam soils is a very doubtful practice; but on these sandy lands August 1 to 15 is one of the best seasons for clover seeding, if not the best beyond question.

A practical modification of the 3-year rotation of corn, rye, and clover may be carried out under the average conditions of these sandy lands. A part of the cornfield may be set aside for soy beans or cowpeas, preferably soy beans. Corn may occupy two-thirds of the field and soy beans for seed may occupy the remainder, or the two crops may be grown in such proportions as conditions may warrant. On the part of the field devoted to corn, at the last cultivation soy beans may be sown ahead of the cultivator. This will extend the beneficial effect of the soy beans over the entire field, but it will be too late to mature seed on the part of the field where soy beans are sown in the corn at this time.

FOUR-YEAR ROTATIONS.

A 4-year rotation of special merit with reference to improving sandy-land farms may be outlined as follows:

First year.....	Corn.
Second year.....	Soy beans.
Third year.....	Corn.
Fourth year.....	Cowpeas.

With this arrangement the usual catch crop of rye or rye and vetch may be sown in both the first and third year corn, to be plowed under in preparing the land for the soy beans of the second year and the cowpeas of the fourth year. If it is thought desirable a part of this rye may be left to ripen to furnish seed and straw for bedding. The character of this rotation in general is such as to make it more suited to the first stages of development and reorganization of the average farm of the section.

After the first stages of development have been passed—which should include the application of limestone or marl—and clover can be grown with reasonable certainty, it is more logical to shift gradually to a 4-year rotation of this character:

First year.....	Corn.
Second year.....	Soy beans or cowpeas.
Third year.....	Rye.
Fourth year.....	Clover.

Generally speaking, this rotation presupposes that from 2 to 3 tons of ground-limestone or marl per acre have been applied to the entire farm, or that one field, at least, has received such an application and that a new field will be thus treated each year before an attempt is made to seed it to clover.

The value of the catch crop of rye or rye and vetch should not be overlooked even after reaching the point where this rotation can be put in operation successfully. This should be sown in the first-year corn or after it is cut, and should be plowed under about May 25 to prepare for the second-year soy beans or cowpeas.

As the development of the farm demands it, the corn-crop acreage may be increased conveniently. This may be done by planting corn in a part of the soy-bean or cowpea field. In this case it would be well to sow an early variety of soy beans broadcast in the corn immediately ahead of the last cultivation. If inoculation has been furnished, this will still give the second-year field of the rotation the benefit of having a legume grown on the entire acreage. As another modification which may be desirable under some conditions, wheat may be substituted for rye in the third year of the rotation. Not until the soil has been well built up should such a change be con-

sidered; for in general on these sandy lands rye produces better than wheat.

With some provision for permanent pasture, this rotation is well suited to a combination of cash crops and dairy farming. It is better suited to hog raising than the 3-year rotation of a similar nature, because the corn crop may be extended to a relatively greater acreage as compared with the other crops.

FIVE-YEAR ROTATION.

In some cases, when it seems wise to grow more corn for feeding live stock than is provided in the shorter rotations and where conditions favor such a plan, a 5-year rotation may be desirable. Everything considered, the following is the most logical:

First year	-----	Corn.
Second year	-----	Soy beans or cowpeas.
Third year	-----	Corn.
Fourth year	-----	Rye.
Fifth year	-----	Clover.

This rotation is suited to the more advanced stages of development of the sandy-land farms of the section. Including clover as it does, the fields must have received the usual application of ground limestone or marl, in order to insure success with this crop. If soy beans have been grown on these fields for several years previous to this application, conditions will have been made still more favorable. Notwithstanding the greater productiveness of the land which this rotation requires, advantage should still be taken of the opportunity to grow a catch crop of rye or rye and vetch in the first-year corn to be plowed under to make ready for the soy beans or cowpeas of the second year. This feature will strengthen the rotation greatly and add much to its general effectiveness.

SIX-YEAR ROTATION.

One of the more desirable plans for a 6-year rotation is to allow the clover of the 5-year rotation to stand 2 years. This can be done by not allowing it to produce seed the first year, or by sowing timothy with the clover and allowing this to be the dominating crop the second year, and to be cut for hay or used for pasture. Pasturing is more in keeping with soil improvement, together with reasonable profit and a good distribution of labor. This, as well as the 5-year rotation, might well be used in connection with dairying or hog raising, together with cash crops, or a combination of all three.

FIVE-YEAR ROTATION, INCLUDING POTATOES AND VETCH.

This rotation, or some modification of it, is being advocated for many southern and central Michigan sandy farms. It is rapidly gaining prominence on the broad sandy-land region farther north

which borders Lake Michigan. In that section it will doubtless be applicable farther north than the rotations which include soy beans and cowpeas as a seed crop. The full rotation is arranged in the following order:

First year.....	Vetch and rye.
Second year.....	Potatoes.
Third year.....	Rye.
Fourth year.....	Clover.
Fifth year.....	Corn.

The vetch crop in this rotation is grown with rye for seed. In harvesting these crops there is always more or less seed which has shattered out on the ground. By going over the field with the disk the most of this is covered and a good stand of volunteer vetch and rye is secured, which is permitted to grow until a short time prior to the first of June of the next year, then is plowed under before planting the potatoes. This is a valuable feature of the rotation which is secured with very little labor and expense. It is a big factor in the production of the potato crop, as well as in the improvement of the soil.

This rotation, likewise, fits in well with the plan which has been kept in mind throughout this work, namely, immediate profits and the improvement of the general farm conditions. It includes two cash crops, vetch seed, and potatoes. Rye also is a fairly profitable crop when sold on the market. The item of soil improvement is provided for with the vetch and clover and the heavy growth of volunteer vetch and rye to be plowed under. Serving as a balance to the rotation, the corn and clover will take care of a limited number of live stock and thus become valuable as feed crops.

SOIL REQUIREMENTS OF THESE SANDY-LAND AREAS.

The soil of these areas varies somewhat, but as a whole is very sandy. The surface is generally a very light gray to whitish-gray sandy loam, in many instances becoming almost pure sand. The subsoil is a yellow sandy loam, with a large percentage of sand and some gravel. This makes a subsoil which is rather porous and affords quick drainage, but naturally the effect of manures and fertilizers is not so lasting as on soils with a clay subsoil. However, these sandy soils as a whole respond readily to proper treatment.

NITROGEN AND HUMUS.

The needs of these soils are many and urgent. One of the first, and possibly the greatest, is that of nitrogen and decaying vegetation, or humus-forming material. This is apparent to the most casual observer. Very light applications of nitrate of soda show a remarkably good effect on the leaf development of all crops. The

growing of soy beans and cowpeas, especially if these are turned under, greatly increases the yield of succeeding crops. The application of straw or vegetable material of any kind gives an immediate benefit.

Although the soils are quite sandy, after heavy rains it is very common for a distinct crust to form on the surface, which must be broken up by thorough cultivation in order to conserve moisture effectively. As legumes are grown, and crops or crop residues are turned back into the soil, this tendency disappears, the nitrogen is increased, and much improvement is noted in crop growth. This is the first and most important step in the improvement of these lands, and until this is done little result may be expected from other lines of treatment.

PHOSPHORUS.

After nitrogen, the next need of these sandy soils to be considered is phosphorus. Information on this has been gathered from experiments conducted by the writer and from the experiences of many successful farmers in the region who have been cooperating in the work. Where phosphorus has been applied in the form of common acid phosphate, it has always given results that have been plainly visible, but the best results have been secured after nitrogen has been increased in the soil and when the phosphorus has been applied in connection with potash. However, on the better class of farms, where the land is of a little heavier nature, phosphorus alone gives very satisfactory results. The improvement which has been obtained from the application of one-half ton of fine ground rock phosphate per acre, together with the plowing under of green crops or manure, also speaks well for this method of soil treatment; but when raw rock phosphate is applied alone on very poor sandy lands of the area, even at the rate of a ton per acre, it has made a very poor showing. Practically all of the sandy land of this region will be benefited greatly by the use of phosphorus, especially if used in connection with green crops plowed under or with manure, or after available nitrogen and vegetable matter have been increased somewhat by growing soy beans or cowpeas.

POTASH.

There is a wide difference of opinion throughout the area as to the necessity of applying potash to these soils. On the better farms, where the soil has been kept up fairly well, there is not so much need of this element; but throughout the experiments by the writer, especially on the poorest of the sandy lands, potash gave very good returns, and greatly increased the effect of both nitrogen and phos-

phorus when used in connection with these two elements. The results were so marked that there can be little question as to the value of potash on most farms on these sandy-land areas, especially where the soil is much depleted. Since the conditions vary somewhat with regard to this element on different farms, it would be well for each farmer to do some experimenting with it.

LIME.

The lack of lime in these sandy soils is becoming generally recognized over the entire section. The great value of finely ground limestone and of marl is very evident in connection with the growing of clover and alfalfa. There are a few farms, which have been kept up by special effort in the way of hauling manure from outside sources, on which clover still can be grown fairly well; but on the average sandy farm of the area the clover crop is extremely uncertain and generally out of the question, even with special care in seeding. Nearly all clover fields are spotted and uneven. Large areas turn yellow, finally die out, and give way to a thin growth of weeds. These results are about the same when clover is sown alone and given the best possible chance to thrive, but with no lime applied.

From the results obtained from the application of limestone and marl on a large number of sandy farms over the general area, there can be little doubt of the extreme value of this practice, especially on farms which are considerably run down. Practically all such farms in the area need lime badly, and even on farms which are in better condition experiments should be made with limestone where there is any difficulty in growing clover successfully. Fortunately, in many localities marl beds have been found from which marl may be had locally for less money than ground limestone, and it is equally effective.

Under average conditions on these sandy lands no attempt of any importance should be made to grow alfalfa without the application of from 2 to 3 tons of ground limestone or marl per acre, and because of such a great and general need of lime in the entire area practically the same may be said in connection with clover.

THE IDLE FIELD.

Fields left idle to grow up in weeds for one or more years are of very common occurrence throughout the area. When the fertility of the soil reaches an extremely low point these fields are turned out to allow nature to improve them temporarily by whatever increase of vegetation may accumulate from the growth of weeds, grass, etc. Very often it happens, however, that the soil has been so reduced in fertility that even the weeds can make only a scant growth. The

results at best are not good. Notwithstanding this, considerable importance is attached to the practice, and when the time arrives to put in another crop, whatever weeds, old stalks, etc., may have accumulated are plowed under, and generally either wheat or rye is sown. After the wheat or rye is taken off the field is left idle till the next spring, when it is plowed again and corn is planted. Thus the cropping system is wheat and corn or rye and corn, with an occasional period of one or more years for the fields to remain idle or uncropped.

Such a system is unprofitable in that the fields yield no income during the idle period, and the slight increase in yield, which results from the land remaining uncropped for a time, does not compensate for this loss. Aside from incurring a loss in this way, an opportunity is missed for growing a crop of soy beans or cowpeas which would be profitable and at the same time improve the soil conditions much more rapidly than this period of inactivity can possibly do. While there is an apparent increase in production by allowing a field to remain idle, there can be no permanent improvement in a cropping system built principally on this idea.

In the long run such a system is very harmful. As generally managed it is one of the surest ways to reduce the productiveness of a farm that can be devised. Throughout the hot growing season there is little protection for the uncropped fields. Because of the sandy nature of the soil, much heat is absorbed and a greater proportion of the organic matter remaining in the surface is burned out and rapidly consumed. Much of the nitrogen liberated by this process is lost because there is no crop on the land to take it up and use it. These sandy lands are very deficient in nitrogen and organic matter already, and it takes special effort in this direction to keep pace with the amounts consumed by ordinary cropping. With the present system this condition is rapidly made worse instead of better. The soil still further loses its power to retain moisture for crop growth and has a greater tendency to crust after rains. The idle field gains little and loses much.

This injurious practice should be supplanted by one that will have an entirely opposite effect. Rye and inoculated vetch seed, or rye alone, should be sown in the corn fields about the middle of August. These crops should be allowed to grow until about May 25 of the next season, and then should be plowed under to prepare for sowing a crop of soy beans or cowpeas by June 1. If this practice were substituted for that of allowing the fields to be idle and grow up to weeds, it would return greater profits, and a great step would have been taken toward the improvement of farm conditions throughout the sandy-land areas of the entire section.

THE INTRODUCTION OF LIVE STOCK.

While it is highly desirable to start the improvement of most of these sandy-land farms on more of a cash-crop basis, it is, indeed, unwise to plan to exclude live stock indefinitely. The experience of other localities where soy beans or cowpeas are grown extensively for seed is that the price holds up well so long as the local demand absorbs the local output, but when it becomes necessary to ship to get a market, the price declines to about \$1 a bushel and remains fairly steady at that level. The demand for early varieties and northern-grown seed may prevent this to some extent in this section, but the presumption is that the present high price for soy-bean and cowpea seed will not prevail in the region long after local demand fails to take care of local supply. It is practically certain that if the production of soy-bean and cowpea seed for sale were to become general over all of the sandy-land areas of the section, the present very attractive price received will eventually fall quite materially. As this stage of development is approached live-stock farming will become more of a necessity. In this case soy beans and cowpeas should still be grown, but to a greater extent for feeding live stock.

There is likewise a great need of live stock as a means of furnishing profitable winter employment on the average farm of the region. This being a northern latitude, very little productive winter work is available on the farm, except as it comes about in connection with the feeding and caring for some kind of live stock. But there should be no immediate haste to get away from the more strictly cash-crop stage and rush into live-stock farming. Sufficient money should be made while on the cash-crop basis to purchase fences suitable for turning live stock, and not until several fields are well fenced should much live stock be kept. Then, too, the soil must be built up to a point where an abundance of feed can be grown. Live stock should come in gradually and in its proper relation to a carefully developed plan.

THE DEVELOPMENT OF DAIRY FARMS.

There are a number of features which tend to make dairying one of the first types of live-stock development to be considered on the sandy-land farms which are favorably located for this industry. It is much easier and cheaper to fence against cattle than against most any other class of live stock. Two or three strands of barbed wire well stretched will furnish a good fence temporarily for cows that have plenty to eat. On many farms this alone will be an important factor in deciding the trend toward dairy farming. Dairy cows also will consume profitably large quantities of roughage produced so readily on these sandy areas by growing soy beans, cowpeas, and

field peas. In this way soil improvement with these crops may continue even better than by seed production. Along with the hay made from these crops, especially that from soy beans cut when the leaves first begin to turn yellow, the addition of Sudan-grass hay furnishes a splendid combination of roughage which makes it unnecessary to feed much grain to dairy cows.

Under the conditions thus developed it is possible to start a dairy farm of simple equipment with small expense. In the beginning at least a silo is not necessary. Soy-bean and cowpea hay, together with Sudan-grass hay, will furnish practically all the feed that is needed. The milk produced on this ration will not be as great in quantity as on silage, alfalfa, grain, and mill feeds, but the cost of production will be much less. The results from this cheaper feed are such that it forms the most logical starting point for a dairy farm where only small capital is available. If, with this simple beginning, experiments with brome grass should add good summer pasturage, a splendid foundation will have been made for further developments, which in due time may include more expensive equipment, the growing of alfalfa, etc.

It is the plan of this bulletin to omit further details in the development of dairy farms in this area, the cropping systems, and systems of marketing. The entire scope of the dairy-farm problem under the sandy-land conditions is too broad to be covered in this bulletin.

THE INTRODUCTION OF HOG RAISING.

The question as to when to introduce hog raising in the farm scheme on these lands should be governed very largely by the progress made in building up the soil. As soon as 30 to 40 bushels of corn per acre can be produced with reasonable certainty, this step may well be considered. Success with clover is desirable also, but not entirely necessary. With corn, soy beans, cowpeas, field peas, and rye, cropping systems may be formed to suit the needs of hog raising on sandy farms in all parts of the area.

These crops and the general conditions which prevail make it advisable at first to raise only one litter of pigs per year. These should be late summer or early fall pigs, in order to avoid the period during midsummer, when, without clover, pasturage on the sandy lands is very scarce. For fall pigs rye pasture will be available till winter, and during the winter months corn, with soy beans fed as hay, will furnish an ideal ration. In the spring rye pasture is available again until May 1 to 10. After this time corn alone will compose the principal part of the ration until the hogs are sold on the market in late May or early June. This makes a very simple system

of hog raising and one which is especially adapted to these sandy lands and to the crops which can be produced without difficulty.

If two litters of pigs are raised per year a different plan must be followed, which in itself must be more complex and bring in several difficulties. Clover or alfalfa should be available for summer pasture. Without one or the other of these crops growing successfully there will be a break between the periods when pasture crops are available. The earliest pasture crop is rye, which becomes too woody for pasture purposes after May 10. Field peas sown early will be available about July 15 to 25. About this time also the ripened rye crop may be hogged down. Soy beans may be pastured as soon as in full bloom, which generally is about August 15, depending somewhat on the variety. Rape, too, will furnish an abundance of fall pasture. But during the period from May 1 to July 25 considerable quantities of grain will be necessary, unless perchance an abundance of skim milk is available to take the place of pasture. Hence, everything considered, under the peculiar conditions which prevail in these sandy-land sections, it is better to confine the earlier efforts at hog raising to the simpler system of producing only one litter of pigs per year.

The feeding of soy beans to hogs during the fall and winter seasons is perhaps one of the most valuable practices to be developed in connection with these sandy-land farms. The simplicity of the operations involved and the results secured are gratifying indeed. The soy-bean crop cut when the leaves first begin to turn yellow, cured, and stored or stacked as hay, and fed as such in addition to corn, gives almost the equivalent to the best summer-pasture conditions and eliminates almost entirely the necessity of buying high-priced mill feeds, tankage, etc. The only exception to this is feeding middlings to small pigs and tankage or meat meal to brood sows for about two months before farrowing. The beans are rich in protein (about 20 per cent), which is the element of food for growth. The oil content also is high, which in itself has a laxative effect. This, together with the large amount of leaves eaten, keeps the hogs thus fed in perfect condition for making the best gains possible. Soy beans fed after this plan make profitable pork production possible during the winter season. Since this scheme fits in so well with the conditions on the sandy lands of this entire section it is indeed important.

CONCLUSION.

The normal stages of development for the average sandy-land farm of this general section should be about three in number.

The first should be that of growing and selling cash crops, among which soy beans or cowpeas for seed should have a prominent place.

The second should be a transition stage, in which live stock is being introduced as rapidly as fences can be purchased and built, and as the farm can be made to produce the necessary feed and pasture.

The third stage should be that of a general and well-diversified farm system, with the proper balance between cash crops and live stock which will afford profitable employment for the entire year, maintain crop production in a reasonably high state, and yield a suitable labor income.

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